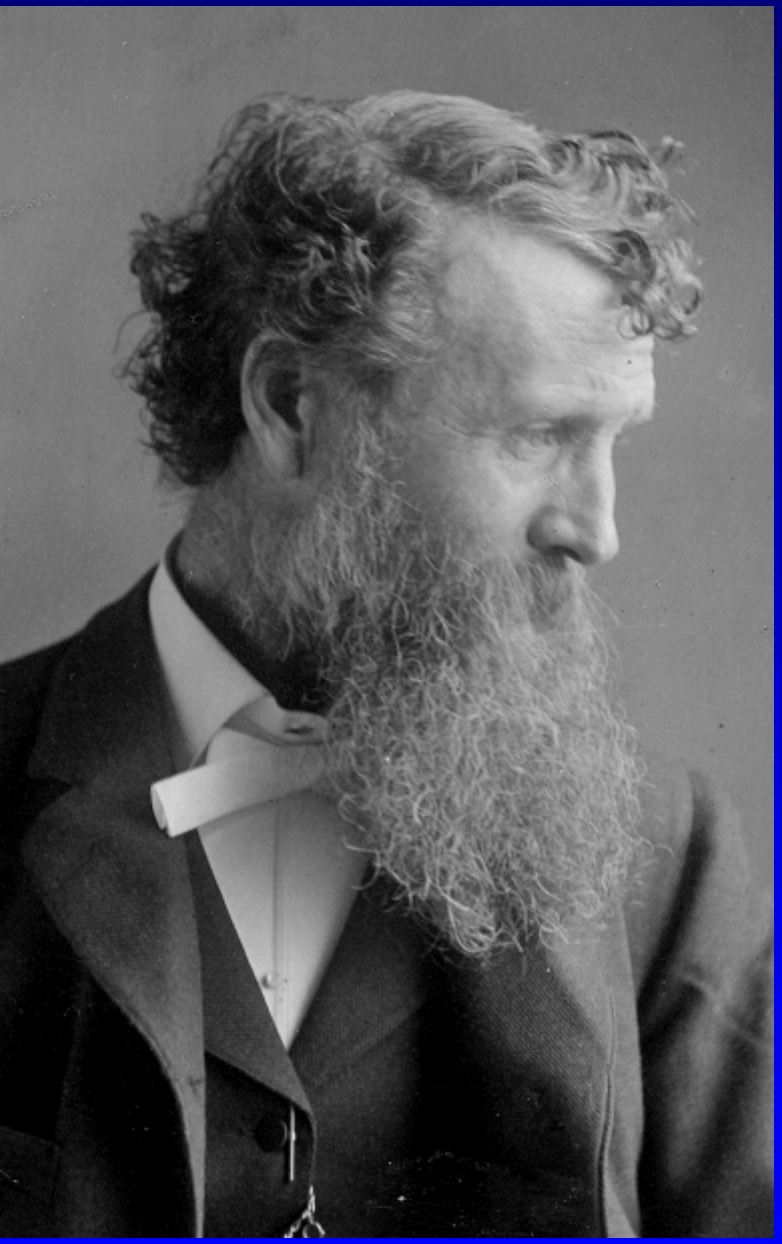
Ecosystem Approach to Protecting, Recovering and Sustainably Using Marine Biodiversity

Elliott A. Norse

Marine Conservation Biology Institute



When we try to pick anything out by itself, we find it hitched to everything else in the universe

John Muir
1838-1914

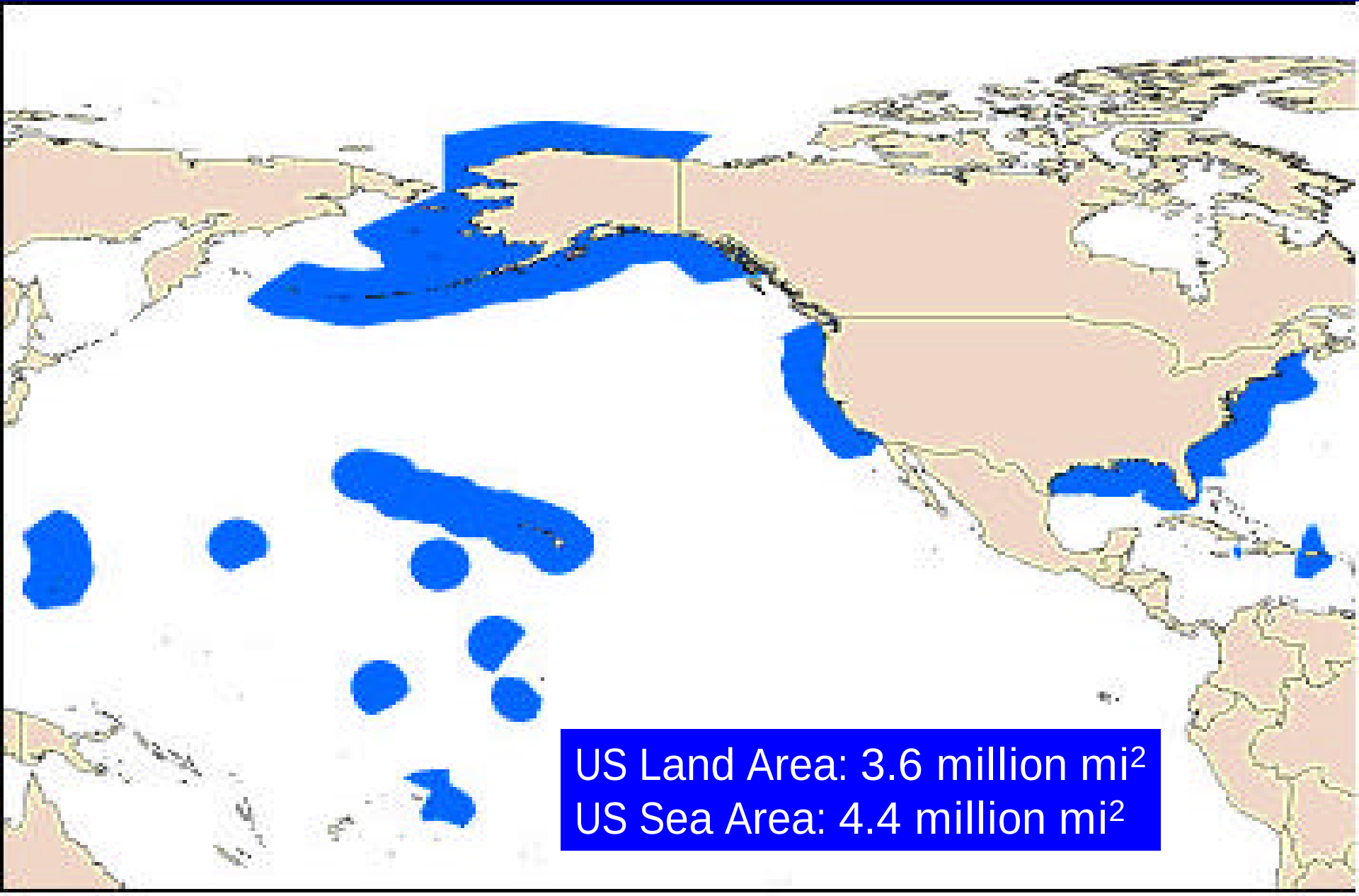
The most dangerous phrase in the language is:
"We've always done it this way"

Admiral Grace Hopper
1906-1992

Please Fasten Your Seatbelts for:

THE ECOSYSTEM APPROACH

US Ocean Jurisdiction











Alarming Ecosystem-level Indicators

- Megafauna are vanishing
- Habitat-formers are vanishing

Scott Eckert, Duke University

Jan Helge Fosså, IMR Norway

Oceanic whitetip shark populations are down *99.7%* in Gulf of Mexico since longlining began in 1950s

J. Baum & R. Myers (2004). *Ecology Letters* 7: 135-145

Masa Ushioda, CoolWaterPhoto.com

Trawling Has Obliterated Seafloor Structure-formers, *Oculina* Banks, Florida

R. Grant Gilmore, HBOI

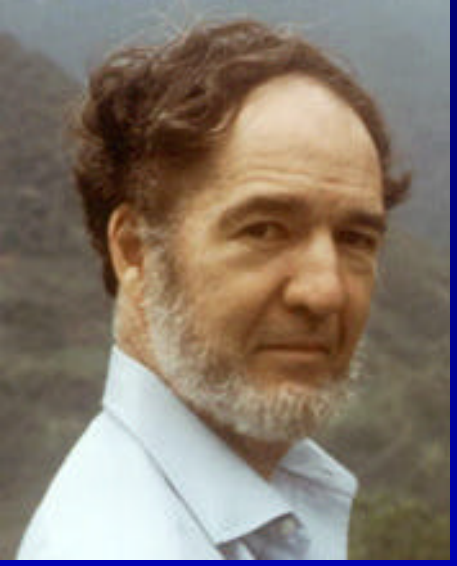
Lance Horn, NURC UNC-W

Many Young Hawaiian Monk Seals Starve

NOAA Fisheries

Seeing These Symptoms, What's Your Diagnosis, Doctors?

- Serial decline of commercially fished species (inshore to offshore, shallow to deep, large to small, desirable to undesirable)
- Decreasing average trophic level of catch
- Declining long-lived nontarget species (elasmobranchs, sea turtles, seabirds, marine mammals)
- Increasing benthic habitat damage
- Explosions of heretofore less common species (e.g. algal blooms and jellyfishes)



A Pertinent Quote from *Collapse* by Jared Diamond (2005)

Any people can fall into the trap of overexploiting environmental resources, because the resources initially seem inexhaustibly abundant; signs of their incipient depletion become masked by normal fluctuations in resource levels between years or decades; it is difficult to get people to agree on exercising restraint in harvesting a shared resource (the so-called tragedy of the commons) and the complexity of ecosystems often makes the consequences of some human-caused perturbation impossible to predict even for a professional ecologist.

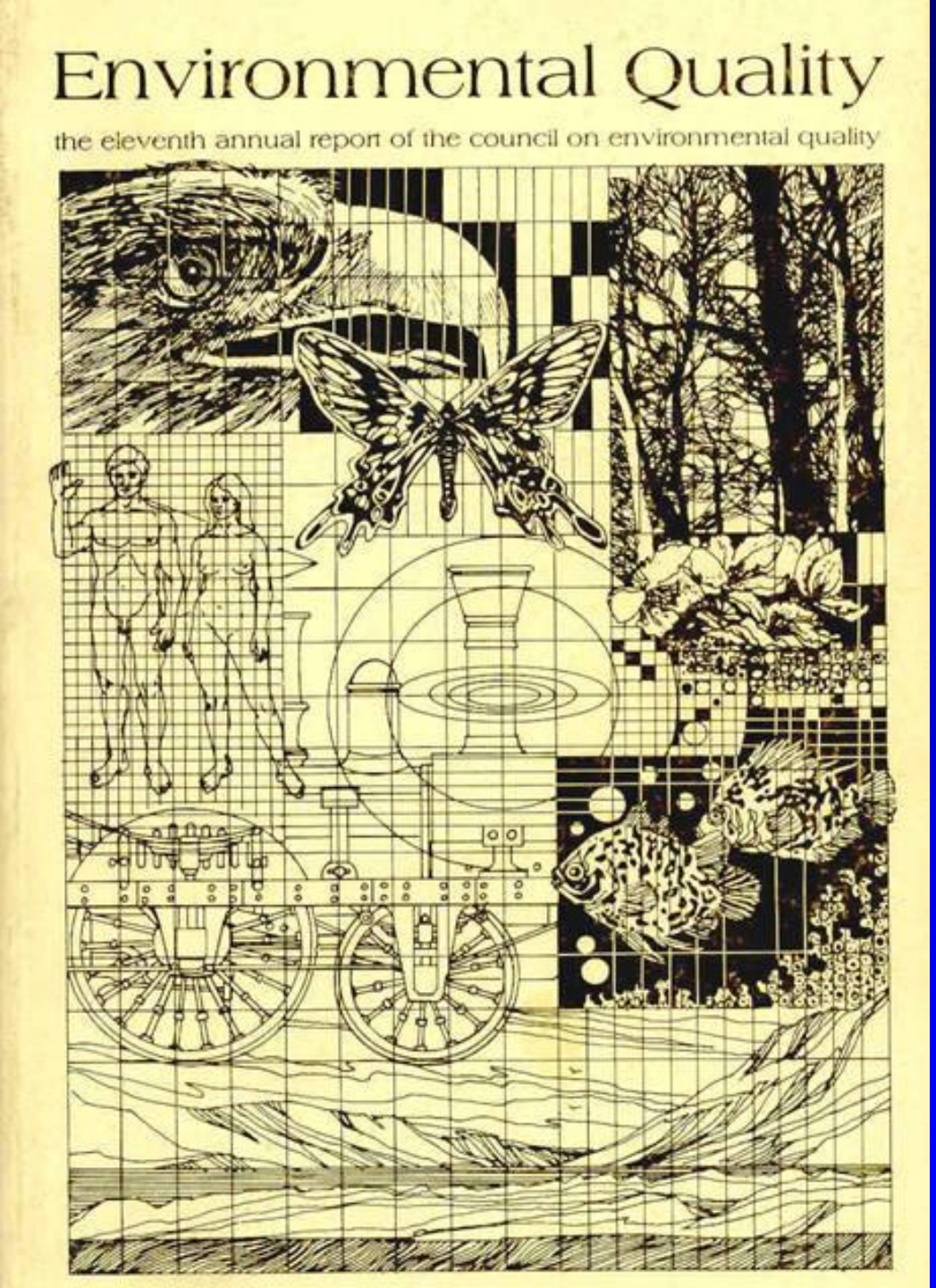
3 Evolutionary Stages in Conservation

Utilitarian
(Focus on use)

Protect species
in danger of
extinction

Protect & recover
biological diversity
and integrity

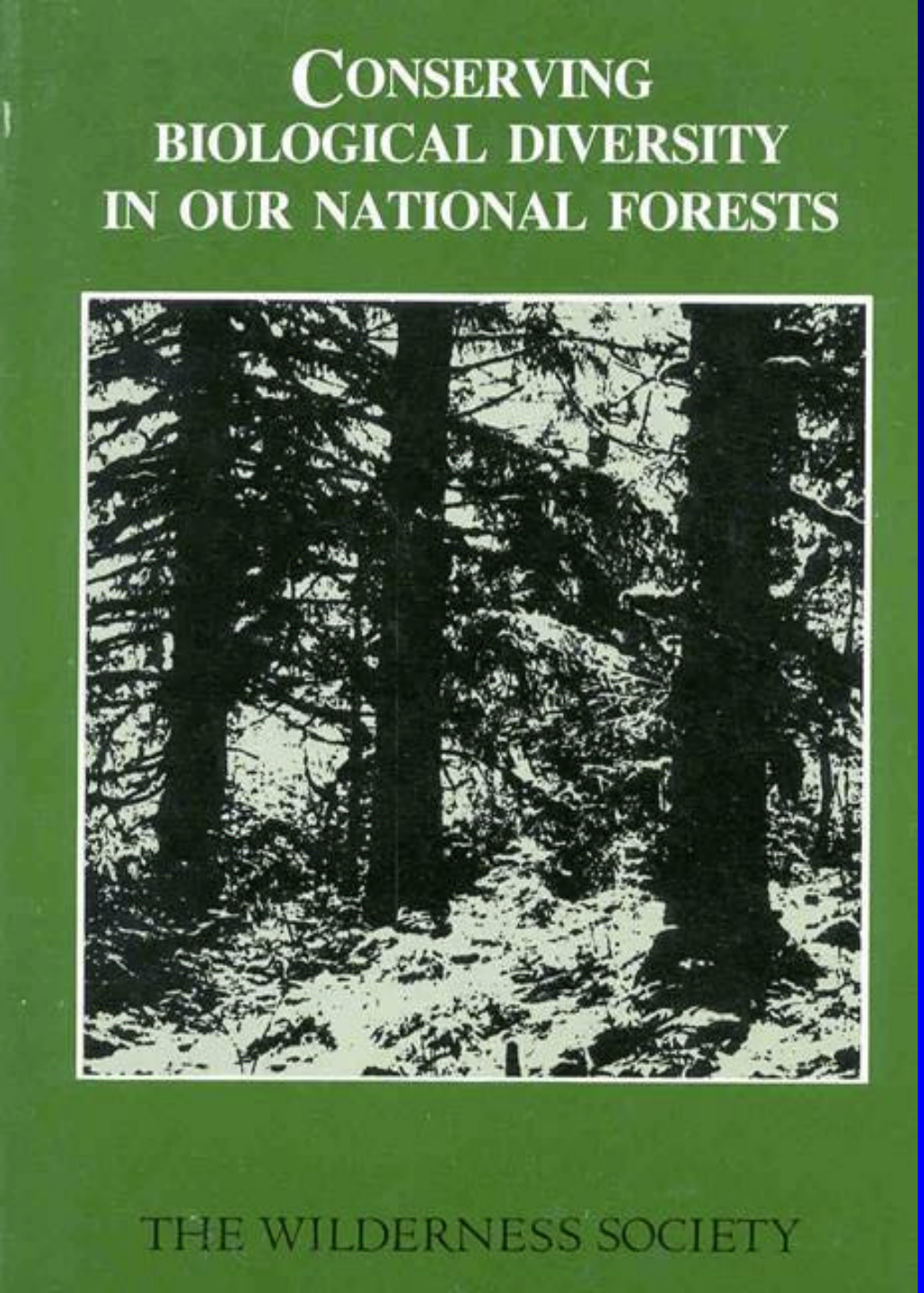
Marine conservation thinking has changed dramatically since I entered federal service in ocean policy 28 years ago



E.A. Norse & R.E. McManus (1980) Biological diversity

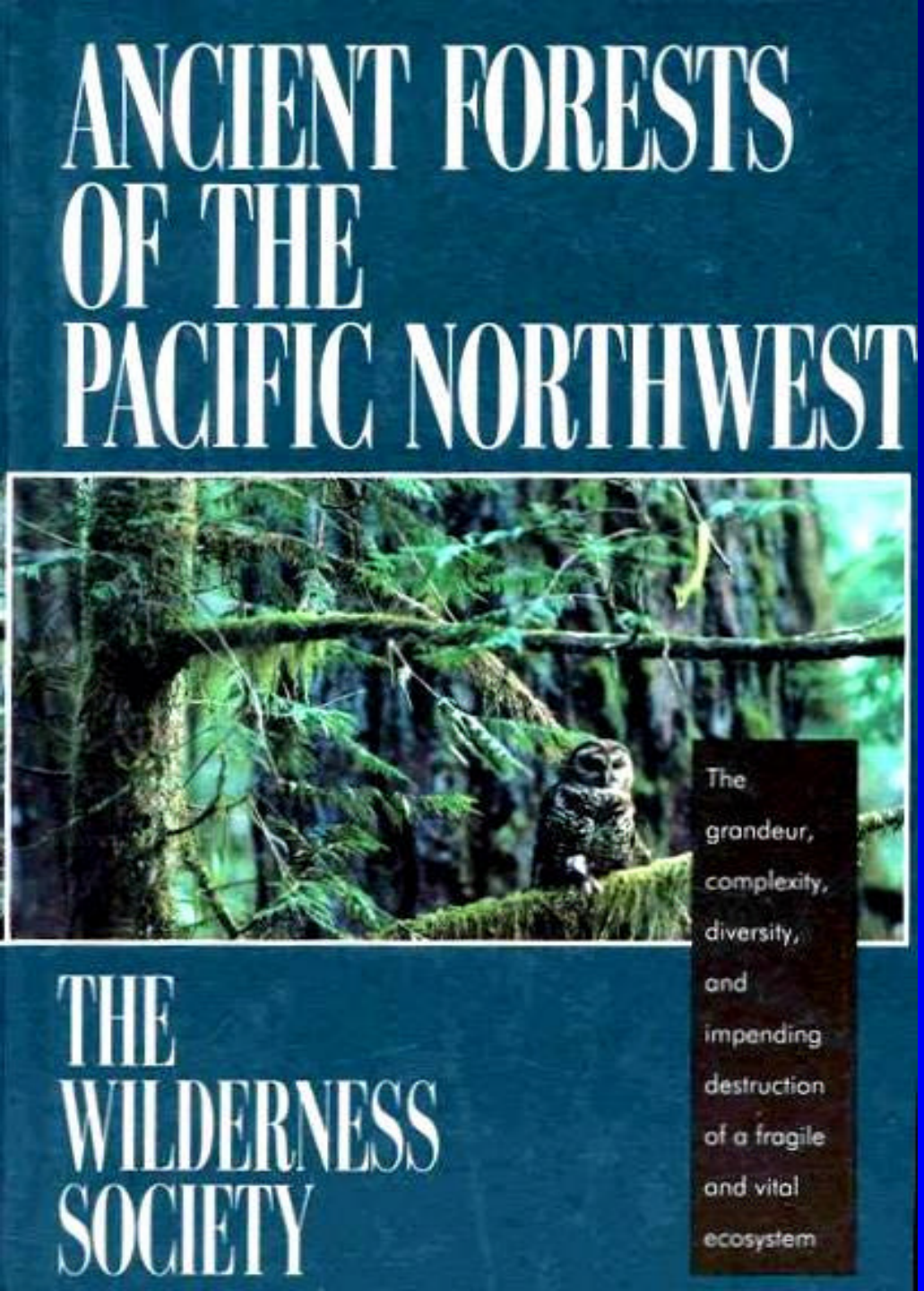
in

11th Annual Report of the Council on Environmental Quality



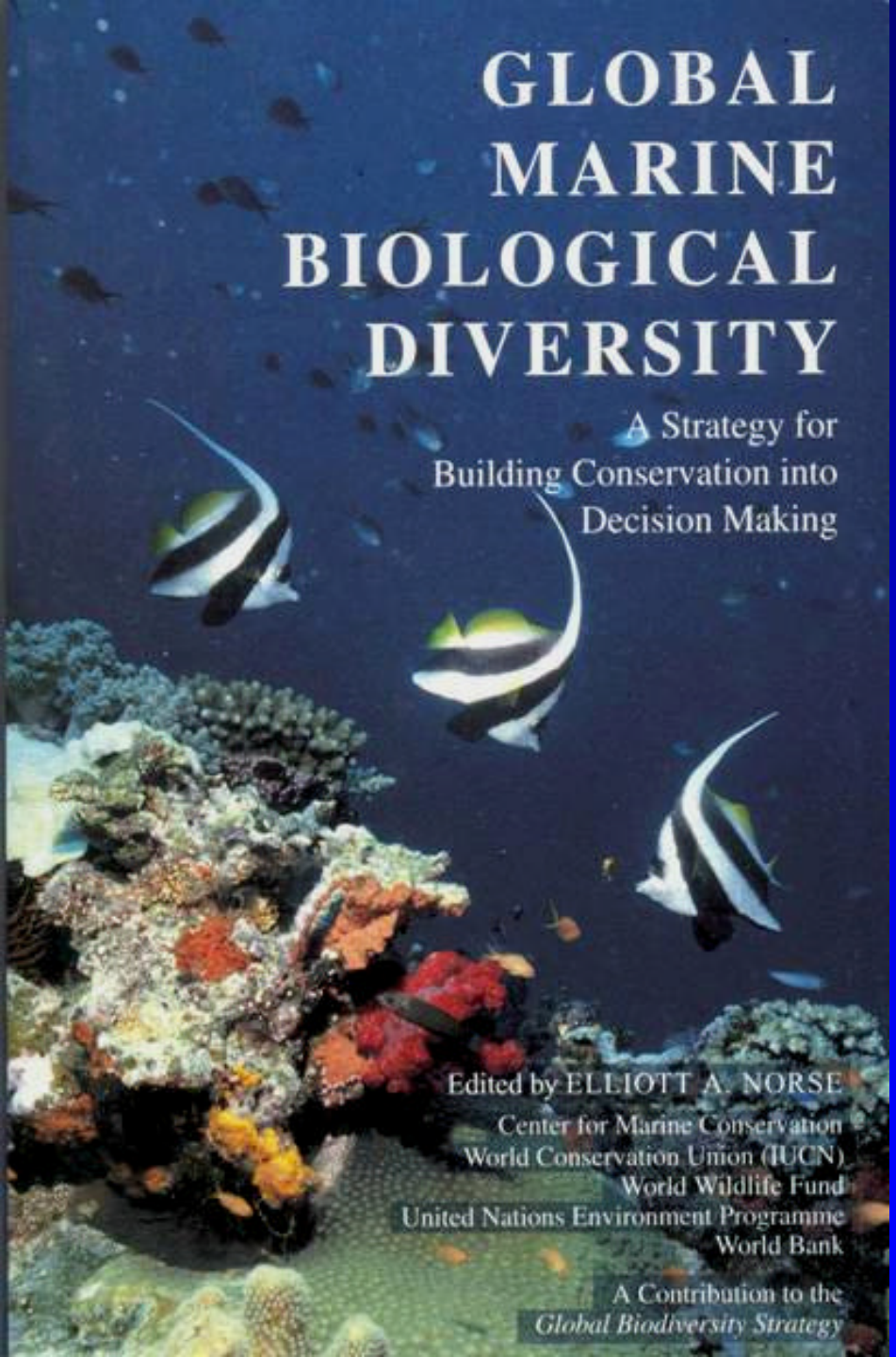
E.A. Norse,
K.L. Rosenbaum,
D.S. Wilcove,
B.A. Wilcox,
W.H. Romme,
D.W. Johnston &
M.L. Stout (1986)

Conserving Biological Diversity in Our National Forests



E.A. Norse (1990)

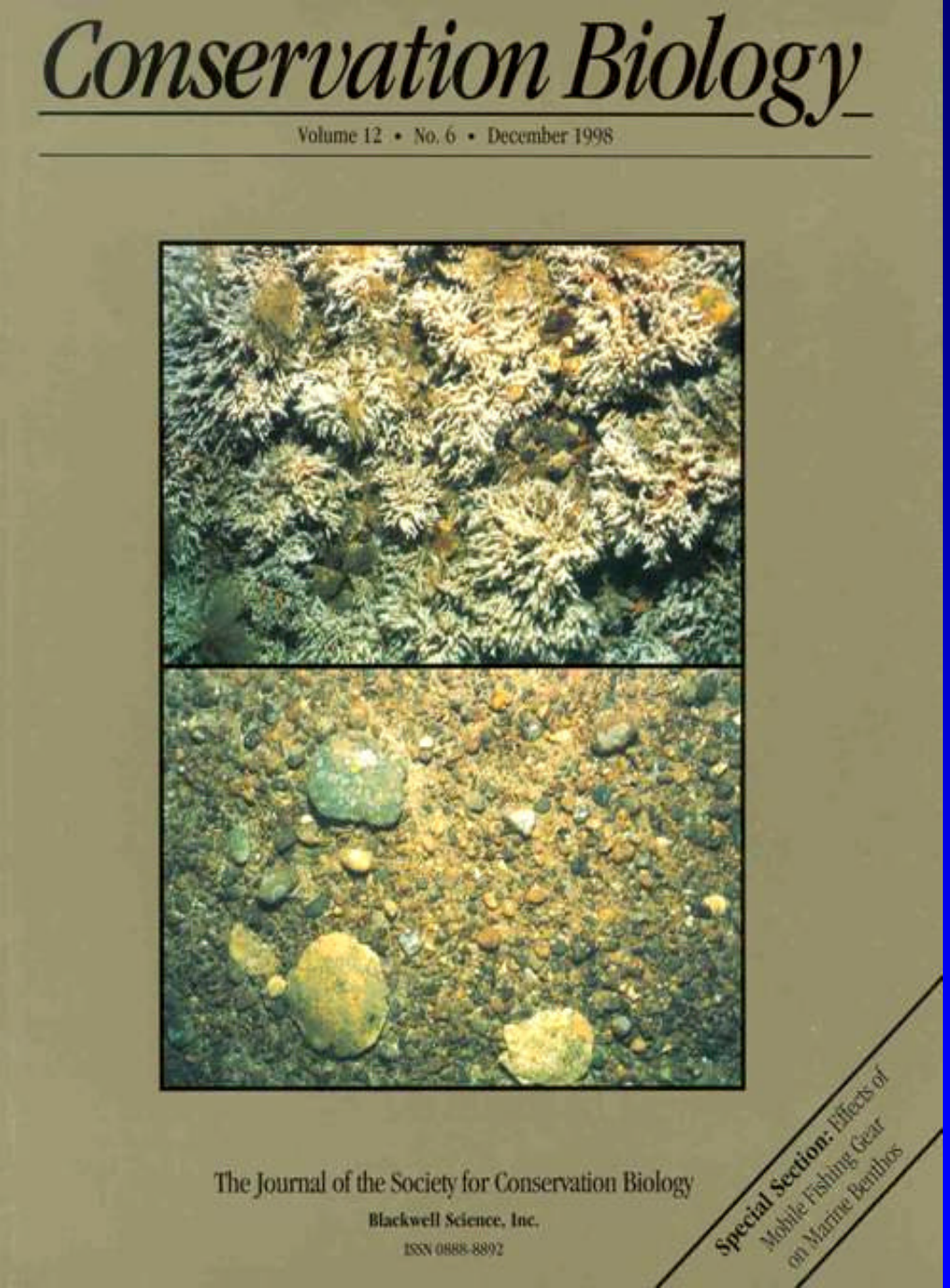
Ancient Forests of the Pacific Northwest



E.A. Norse, ed. (1993)

Global Marine Biological Diversity:

A Strategy for Building Conservation into Decision Making

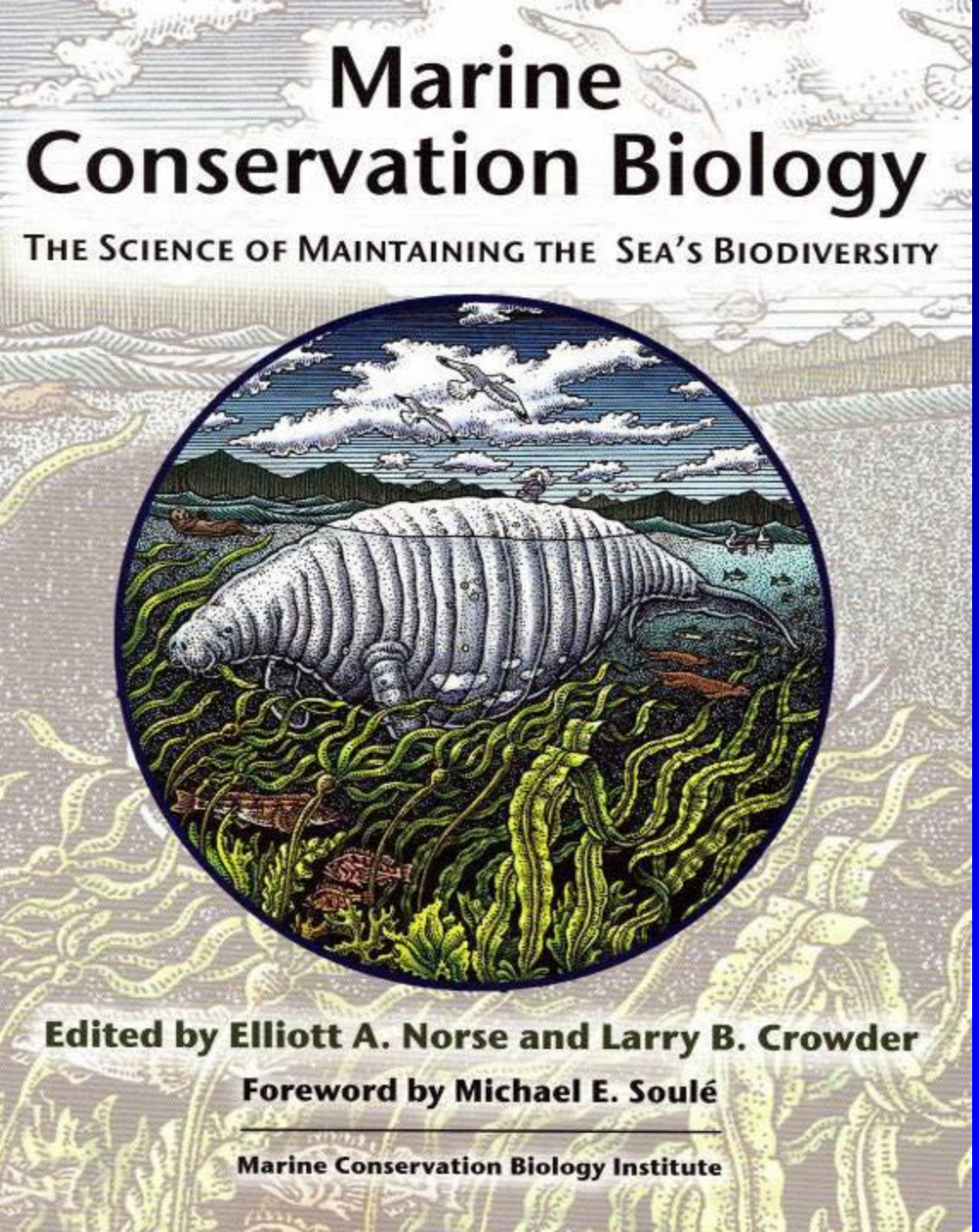


L. Watling & E.A. Norse (1998)

Disturbance of the seabed by mobile fishing gear:

A comparison with forest clearcutting

Conservation Biology 12(6): 1180-1197



E.A. Norse &
L.B. Crowder, eds.
(2005)

Marine Conservation Biology:

The Science of Maintaining the Sea's Biodiversity

Stock Assessments Fail to Address That:

- Marine animals live in habitats; you can't manage them without maintaining *habitat* composition, structure and function
- Marine species interact, so they need to be managed as components of interaction webs
- Habitats are patchy and marine populations have metapopulation dynamics, so maintaining connectivity is crucial
- Different age classes make very unequal contributions to population resilience

Fisheries Biology Underestimates Importance of Behavioral Ecology

F. Coleman & S. Williams (2002) *Trends in Ecology & Evolution* 17: 40-44 found that red groupers keep reef rock clear of sediment

Overfishing such *"ecosystem engineers"* could inhibit recruitment of corals and sponges

Fisheries Biology Underestimates Food Web (Especially Top-down) Ecosystem Effects

Of the 500 most recent citations of R.T. Paine (1966)

Food web complexity and species diversity

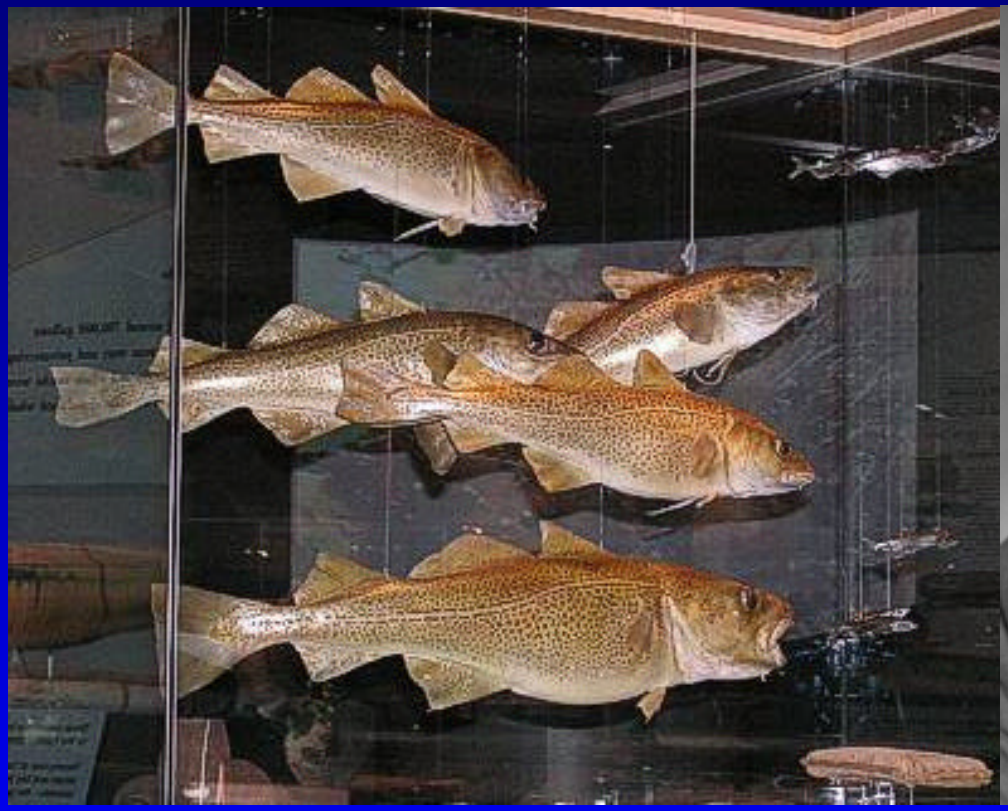
American Naturalist 100: 65-75

only 5 are in fisheries journals



Fisheries Biology Has Overlooked Shifting Baselines


The First Fatal Blow to the Old Paradigm



Larkin, P.A. (1977). An epitaph for the concept of maximum sustained yield

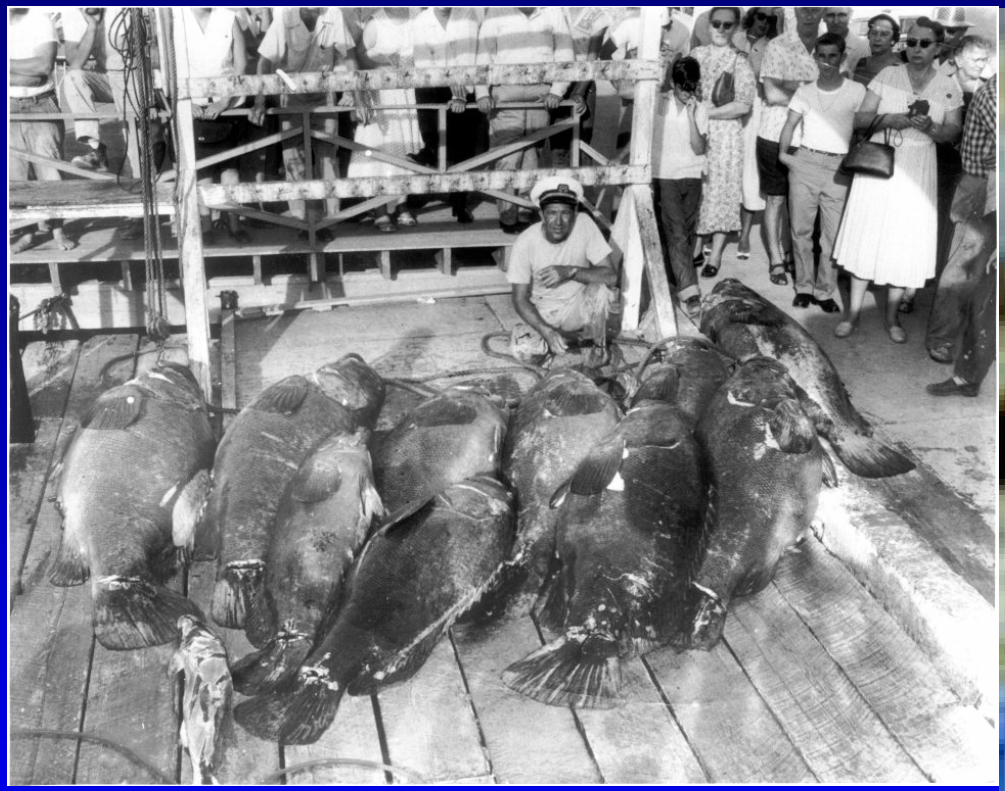
Transactions of the American Fisheries Society

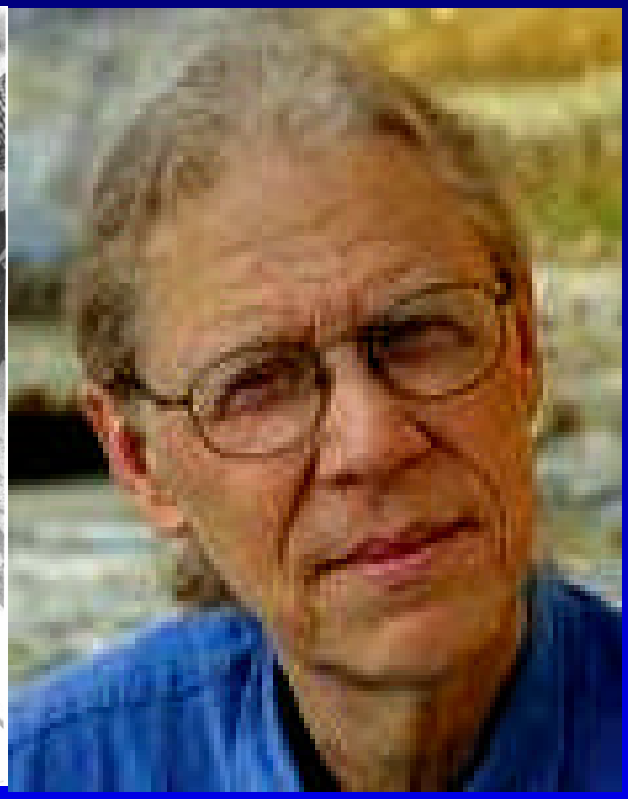
106 (1): 1–11

Another Fatal Blow to the Old Paradigm

D. Pauly, V. Christensen, J. Dalsgaard, R. Froese and F. Torres (1998). Fishing down marine food webs. *Science* 279: 860-863

Yet Another Fatal Blow to the Old Paradigm





J. Jackson and 18 co-authors (2001)
Historical overfishing and the recent collapse of coastal ecosystems
Science 293: 629-638

The Final Fatal Blows to the Old Paradigm

S.A. Berkeley, C. Chapman & S.M. Sogard (2004) Maternal age as a determinant of larval growth and survival in a marine fish, *Sebastes melanops*. *Ecology* 85: 1258-1264

S.A. Berkeley, M.A. Hixon, R.J. Larson & M.S. Love (2004) Fisheries sustainability via protection of age structure and spatial distribution of fish populations. *Fisheries* 29(8): 23-32

Industry Still Presses NOAA to Make Appalling Choices!

Dumb: Pacific Fishery Management Council is considering allowing commercial krill fishery

Dumber: Western Pacific Fishery Management Council is pushing to reopen spiny lobster fishery in NW Hawaiian Islands Sanctuary

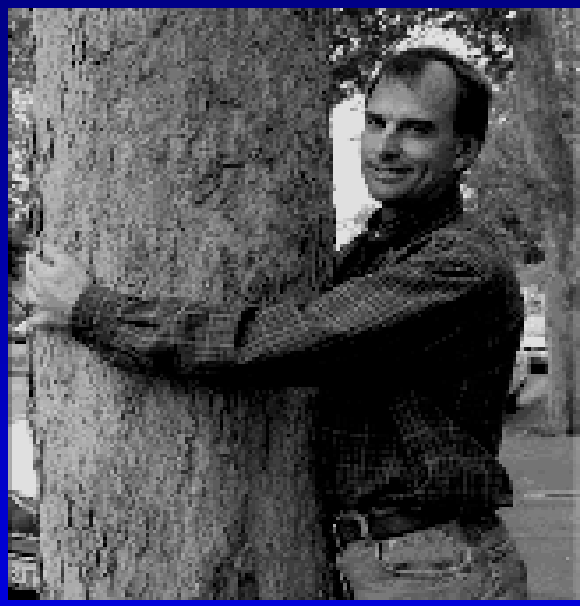
How You Must Feel

Growl!

I'll lose my job!

Being in the middle is so hard!

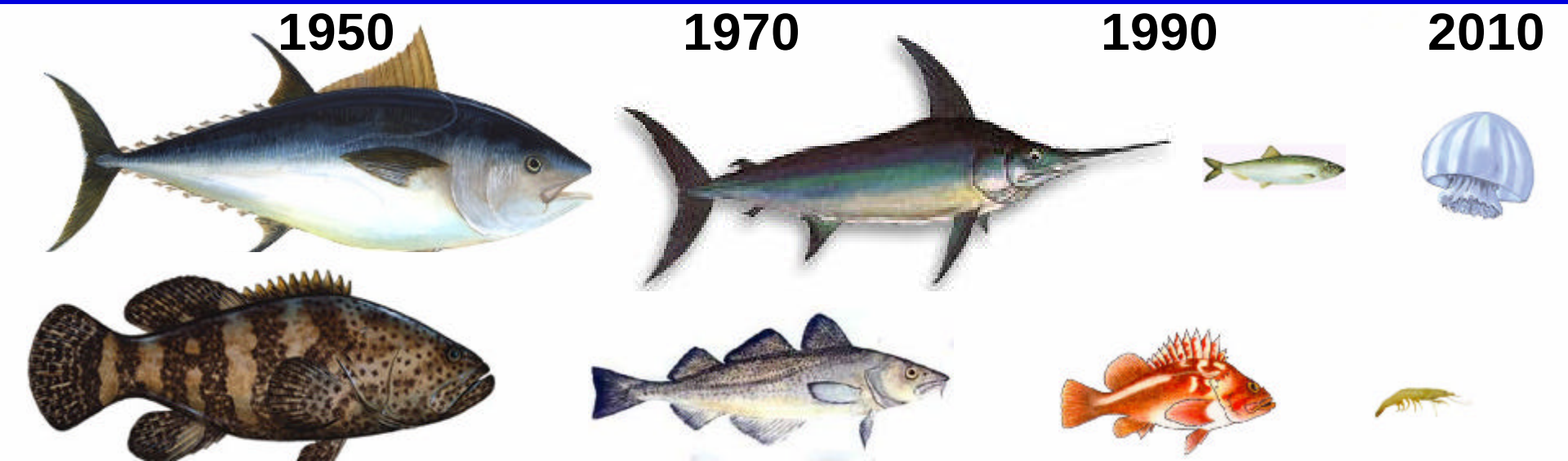
NOAA Fisheries



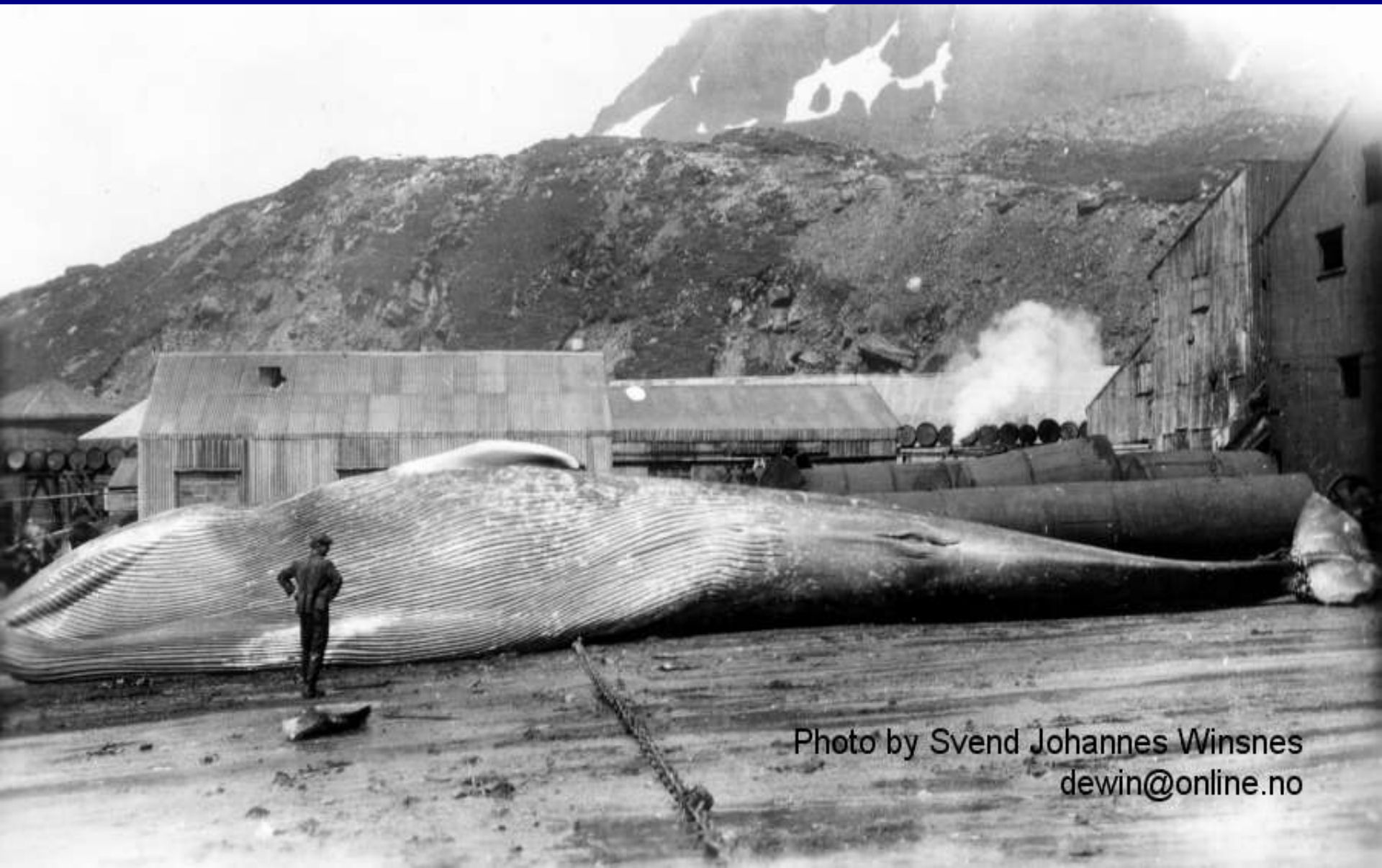
I'll lose my planet!

The Truth is:

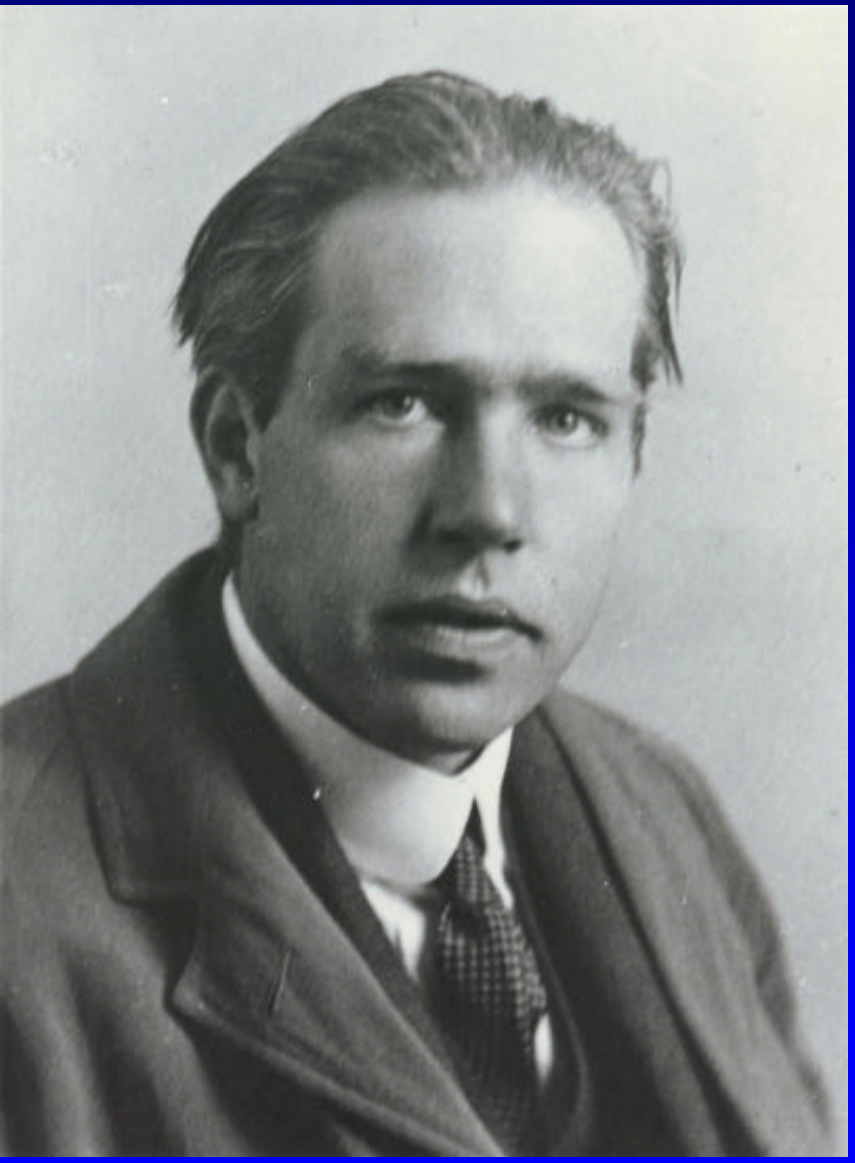
- NOAA Fisheries has had a definite leaning
- Our marine species, ecosystems and fisheries are in deep trouble
- It's *not* too late to change things
- Doing so will benefit our oceans and NOAA
- I'm here to help



Ocean Management Systems Change

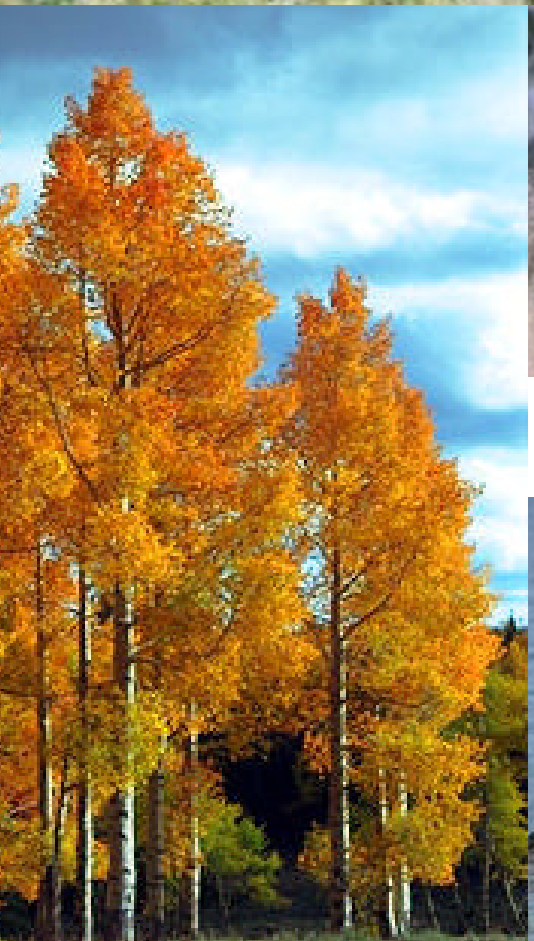


Systems Change Because *We* Change Them



Science progresses one death at a time

Attributed to
Niels Bohr
1885-1962

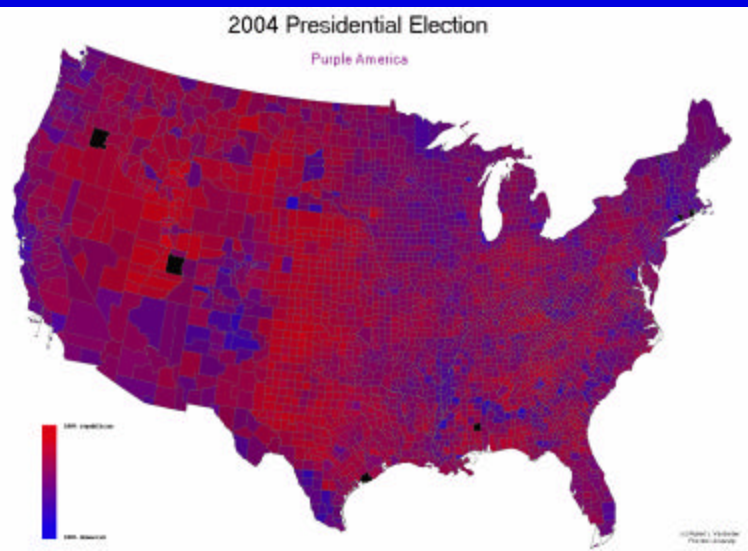


Reintroducing the Keystone Predator

Complex Systems

Definition: systems with multiple components whose interactions produce system behaviors that cannot always be predicted from knowing how individual components work

Examples: stock markets, baseball playoff races, presidential elections, *marine ecosystems*



The Most Important Thing to Understand About Complex Systems

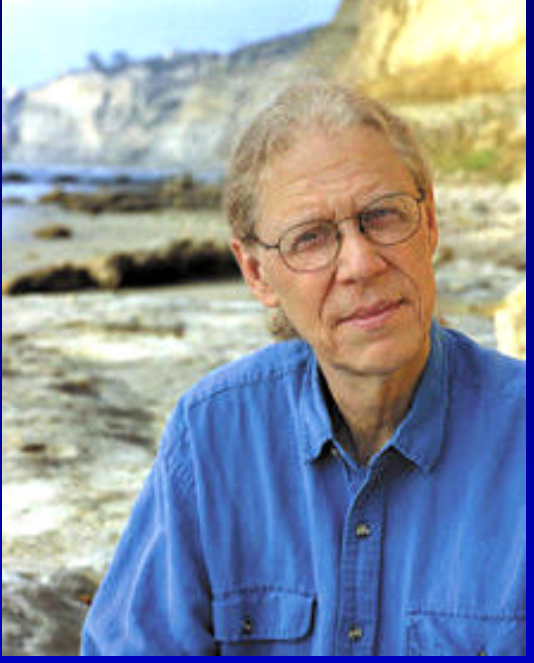
Linear forcing causes nonlinear responses; i.e., they undergo phase changes

Looe Key FL 1977

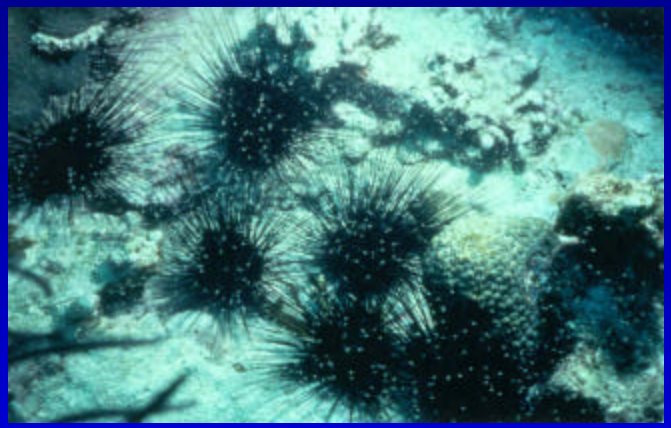
Elliott Norse

Looe Key FL 2004

Brian LaPoint



J. Jackson (2001) in *Proceedings of the National Academy of Sciences* 98: 5411-5418 explains:



- Western Atlantic coral reefs underwent a dramatic phase shift in the 1980s
- Algae overgrow corals when *Diadema* sea urchins—the last major grazers after large herbivorous fishes were fished out—succumbed to an epidemic

I Celebrate NOAA Fisheries' Intentions to Shift to the Ecosystem Approach

My Best Advice on the Ecosystem Approach

DON´T PANIC!

A journey
of a thousand miles
must begin
with a single step

Lao-Tzu
6th Century BCE

Scientific Consensus on Marine Ecosystem-based Management (2005) www.compassonline.org

Ecosystem-based management:

- protects ecosystem structure & functioning
- is place-based, focusing on activities affecting specific ecosystems
- maintains species and key services
- acknowledges interconnectedness among systems, e.g., air, land and sea
- integrates ecological, social, economic, and institutional perspectives

To keep every cog and wheel is the first precaution to intelligent tinkering

Aldo Leopold
1887-1948

When the only tool you have
is a hammer,
you tend to treat everything
as if it were a nail

Abraham Maslow
1908-1970

Which Ecosystem Attributes Should We Manage For?

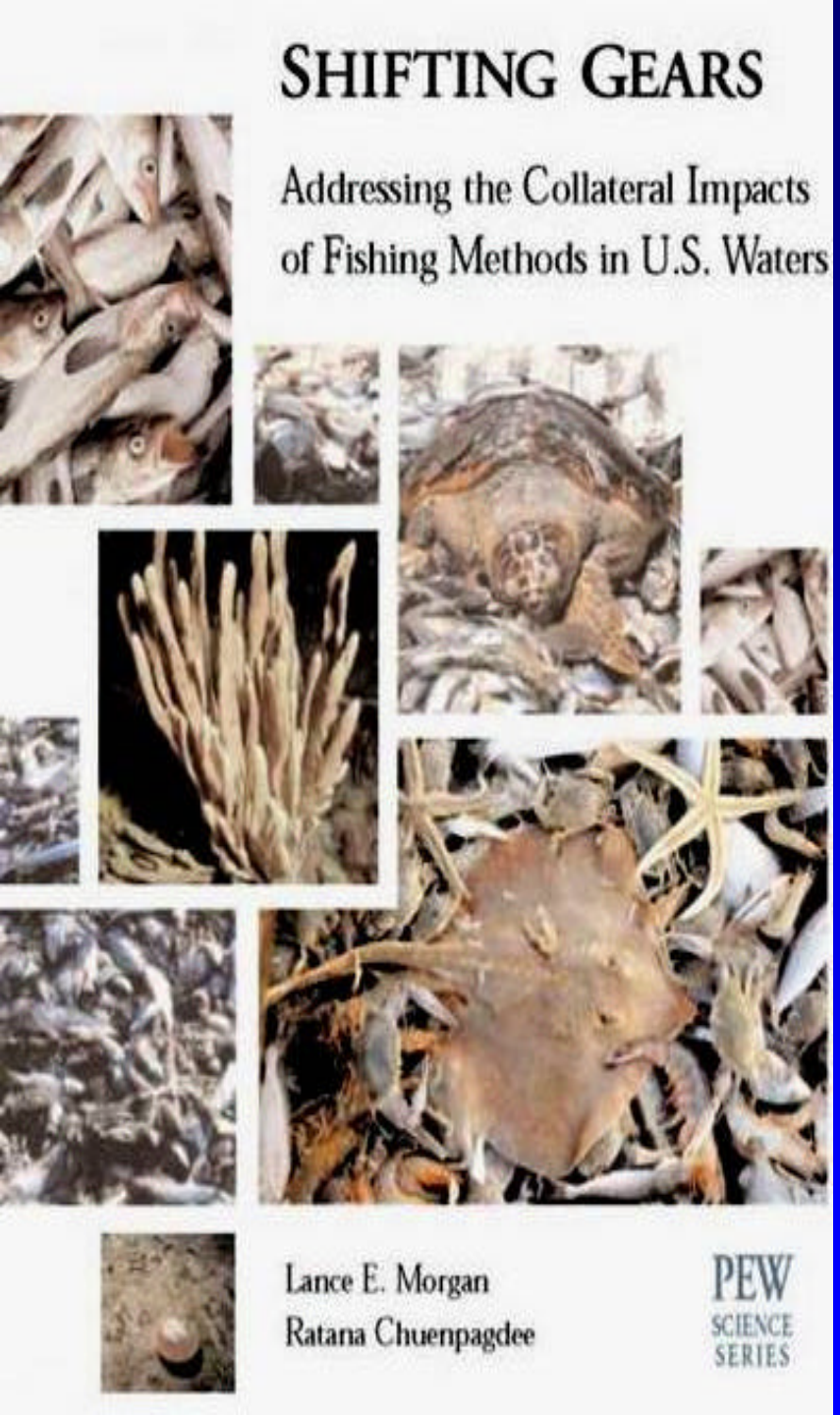
- Composition (species diversity, abundance)
- Spatial structure (habitat complexity)
- Key functions
  - Connectivity
  - Food webs
  - Biogeochemistry

Key Take-home Points (1st Set)

- Ecosystem-based management is not new; people have done it on land for decades
- The goal is to maintain ecosystem integrity and resilience in a changing world
- The perfect is the enemy of the good; phase in ecosystem approaches
- Fisheries depend on the sea's ecosystem goods and services, not vice versa
- No one tool will suffice; use a toolkit

Key Take-home Points (2nd Set)

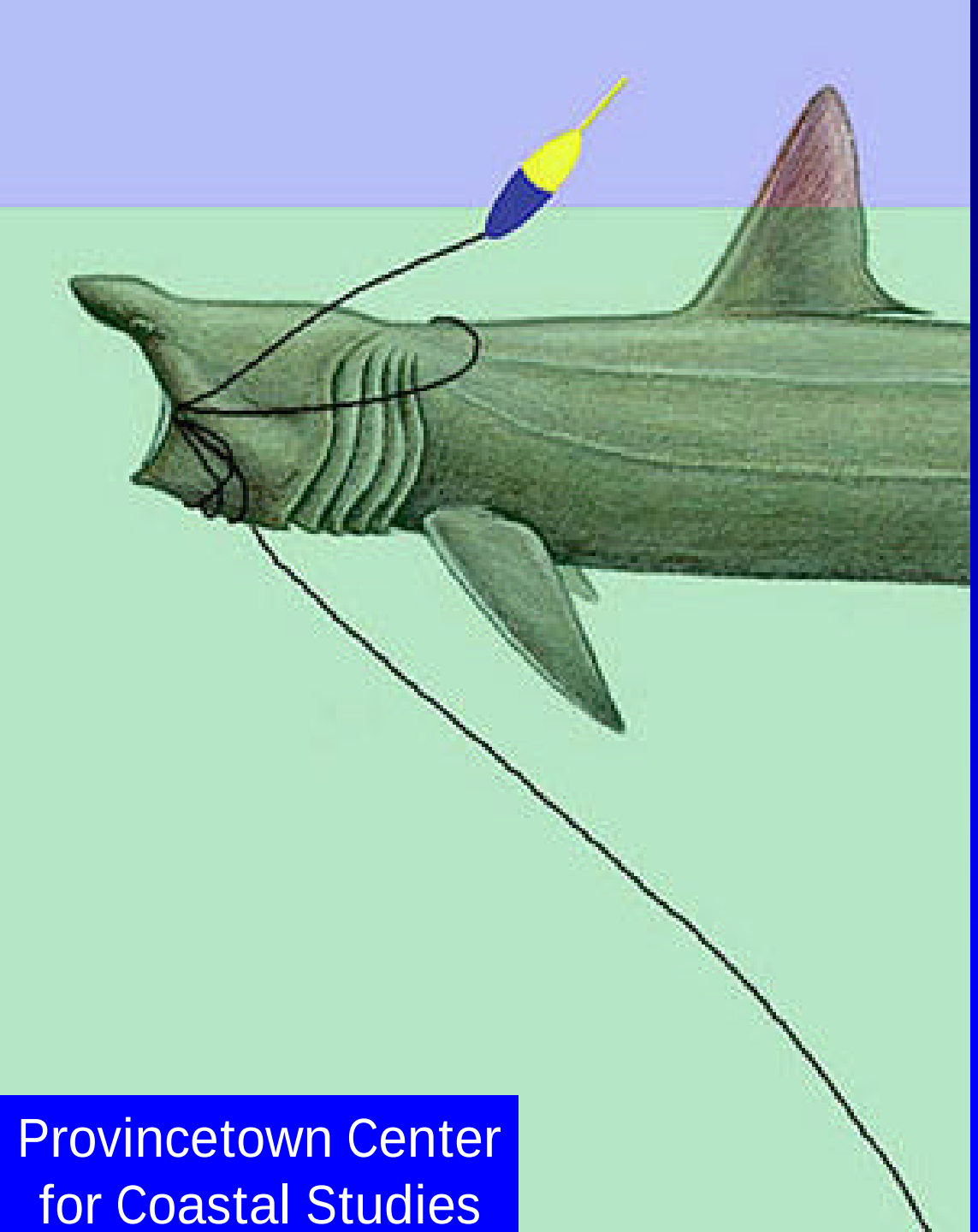
- The first imperative: keep all the parts
- Keystone predators, ecosystem engineers and structure-formers are crucial
- Endemic and bet-hedging species with high biomass and slow population recovery rates are especially vulnerable
- Solutions will be place-based, focusing on what people do and where
- Start now, learn from mistakes



It's not only *how many* fish are caught that counts; it's also *how* they're caught

L.E. Morgan &
R. Chuenpagdee (2003)

Shifting Gears: Addressing the Collateral Impacts of Fishing Methods in U.S. Waters



A Strong Case for the Ecosystem Approach:

Basking Shark Entanglement

Provincetown Center for Coastal Studies

A Strong Case for the Ecosystem Approach: Smalltooth Sawfish Entanglement

Florida Museum of Natural History

A Strong Case for the Ecosystem Approach: Leatherback Sea Turtle Entanglement

Provincetown Center for Coastal Studies

A Strong Case for the Ecosystem Approach:

Albatross Entanglement

Graham Robertson,
Australian Antarctic Division

A Strong Case for the Ecosystem Approach: Hector's Dolphin Entanglement

Stephen Dawson

A Strong Case for the Ecosystem Approach: North Atlantic Right Whale Entanglement

Provincetown Center for Coastal Studies

Managing Marine Systems is Inherently More Difficult than Managing Land

- The sea is opaque and hostile to humans, limiting direct observation
- Ship time is very expensive, limiting sampling opportunities
- With standard tools it's difficult to trace movements of adults and juveniles, and impossible to trace movements of larvae
- The sea varies markedly in space and time

Even the Simplest Food Webs are Complex

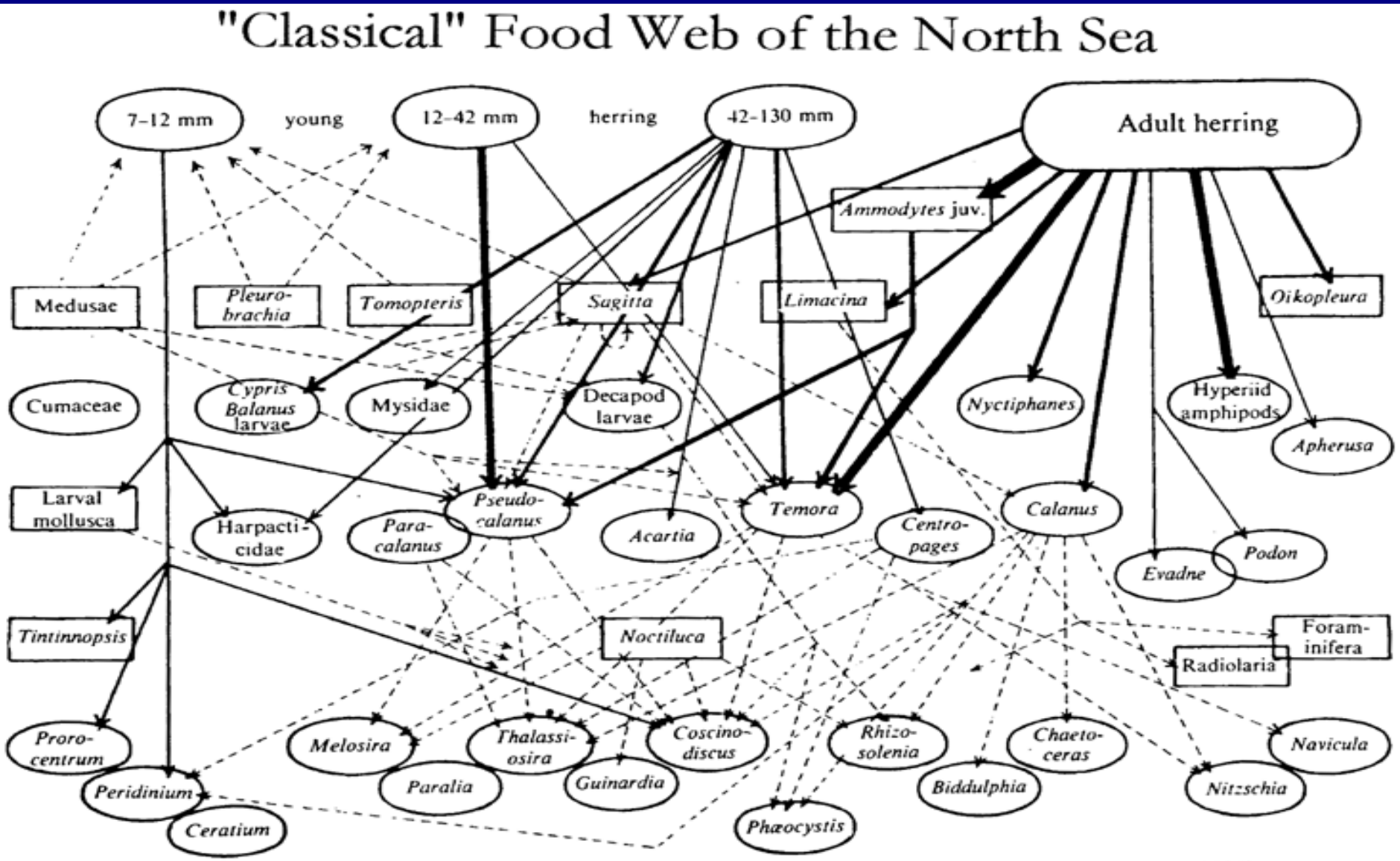


Figure 55. The food web upon which the North Sea herring depends during its life cycle (Hardy, 1924).

It Can Be Difficult to Predict Ecosystem Behavior

- We haven't identified all the components
- We don't know how the components behave under all conditions
- We seldom know causes of tipping points

The Ecosystem Approach Can Require Us to Make Difficult Choices

NOAA Fisheries

And ***Most of All***

- Ecosystem-based management is about managing an unruly species

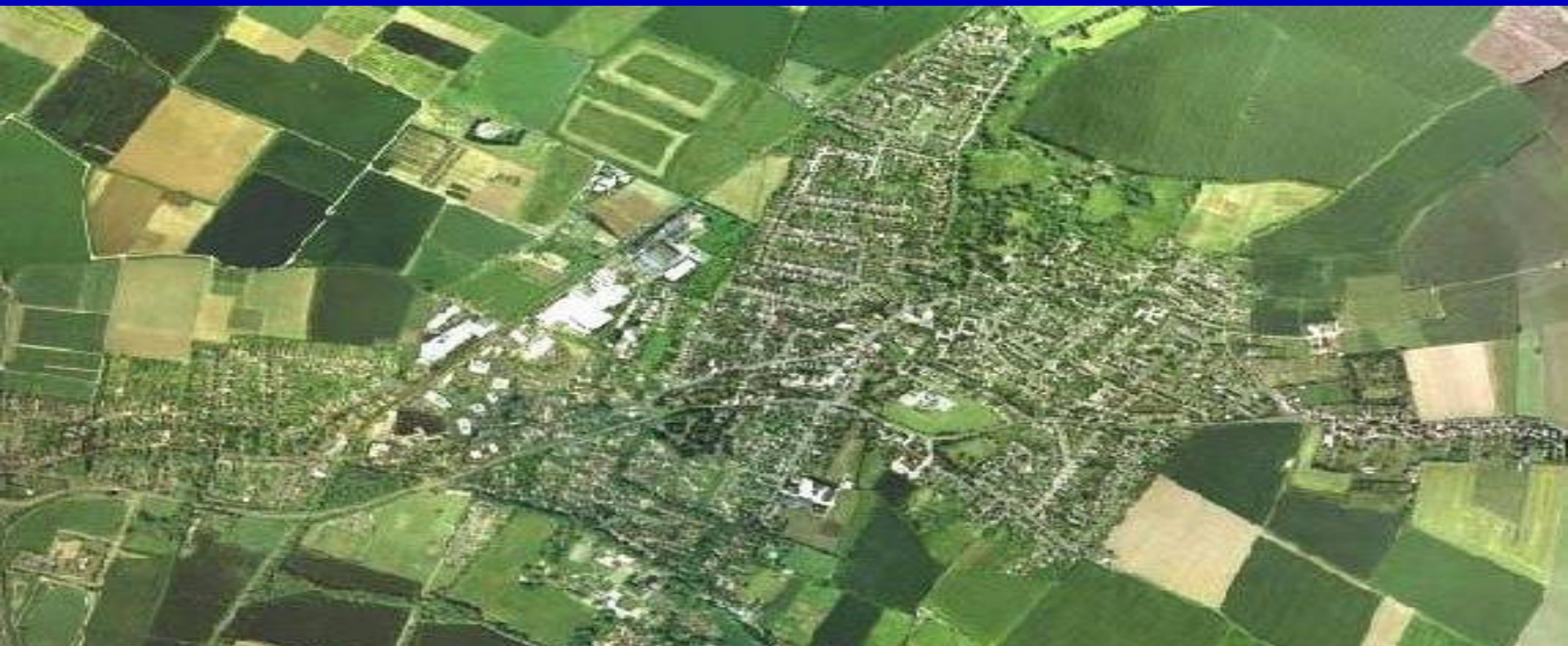
Biologists Alone Aren't Enough

- Understanding population dynamics and food webs is not sufficient
- Most of us have little or no formal training in understanding or managing people
- Ecosystem-based management must integrate natural and social sciences


Marine ecosystem-based management will develop in phases over decades, but there are key steps we can take now

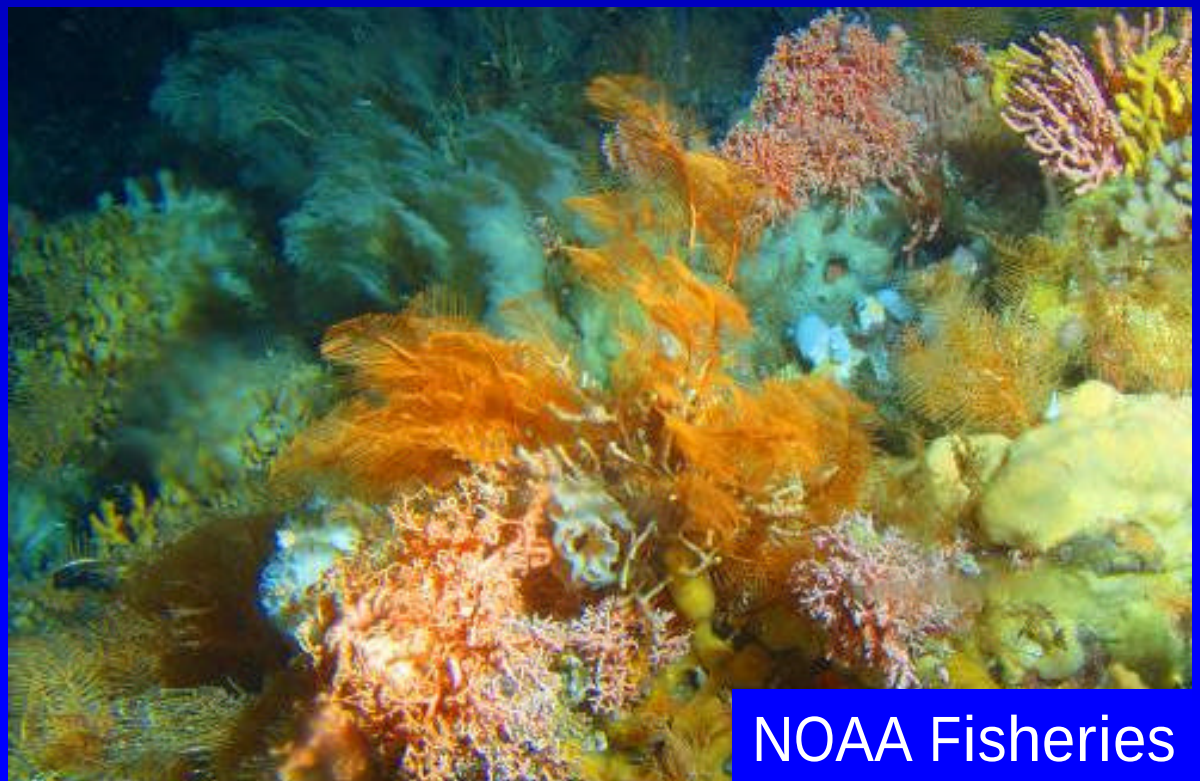
We Can Use Zoning

Definition: A place-based ecosystem management system that reduces conflict, uncertainty and costs by separating incompatible uses and specifying how particular areas may be used



Benefits of Zoning

- It dramatically reduces the pernicious effects of open-access competition
- It addresses the sea's heterogeneity



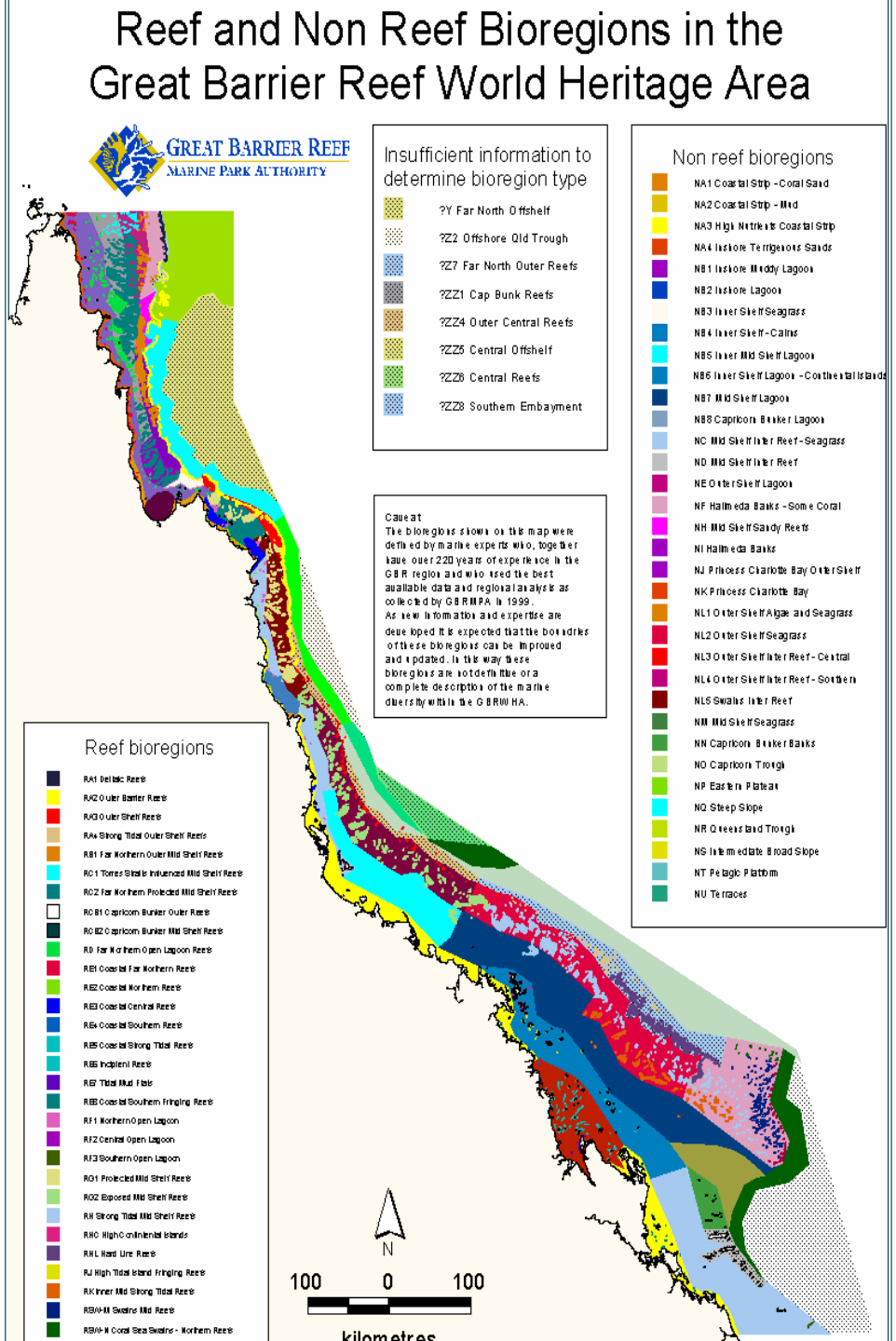
NOAA Fisheries

2 Ways to Zone

1) Piecemeal, by placing zones in certain places for certain purposes without regard to others

or

2) Comprehensively, by assembling zones throughout an area by considering all acceptable uses

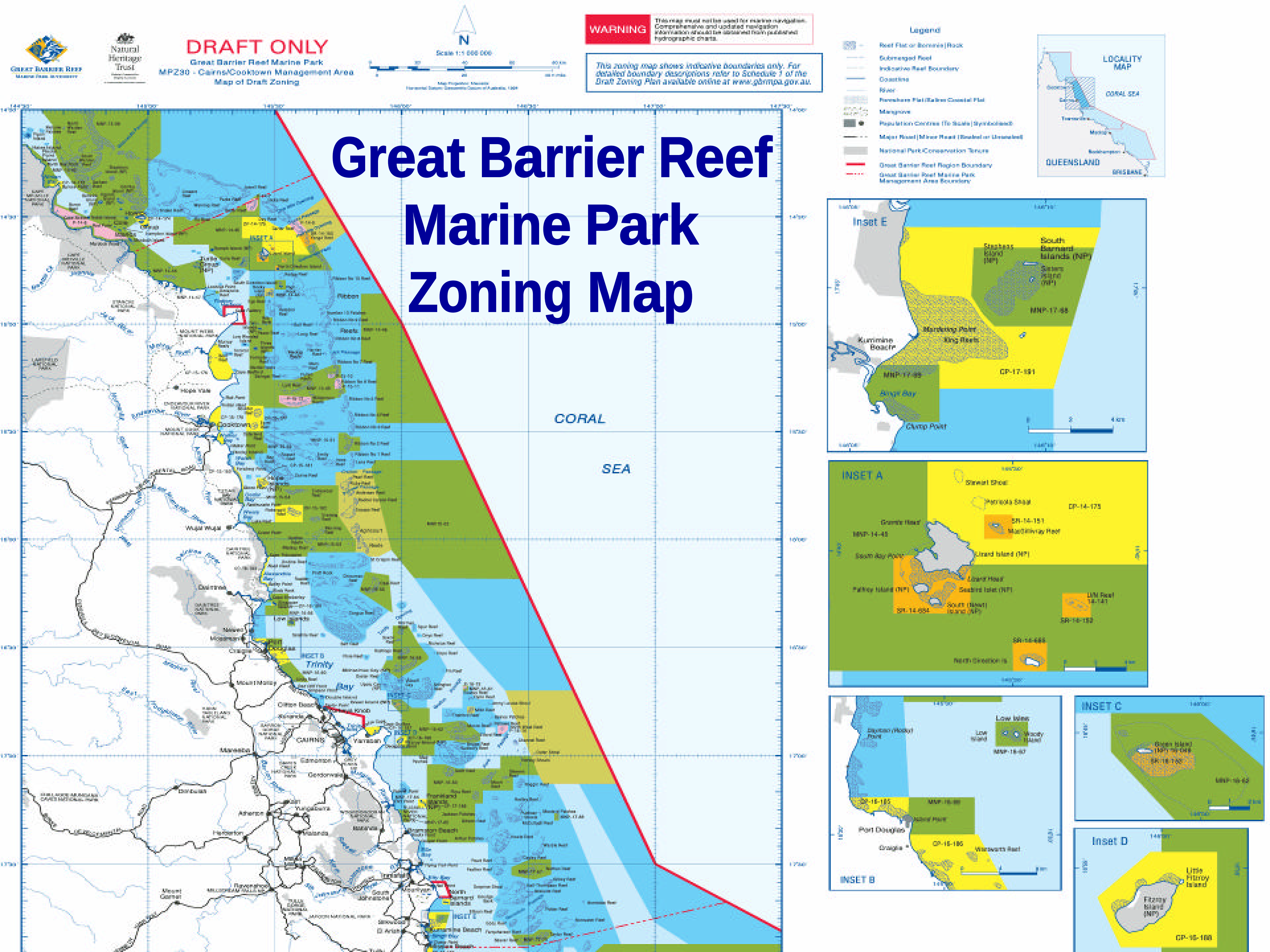


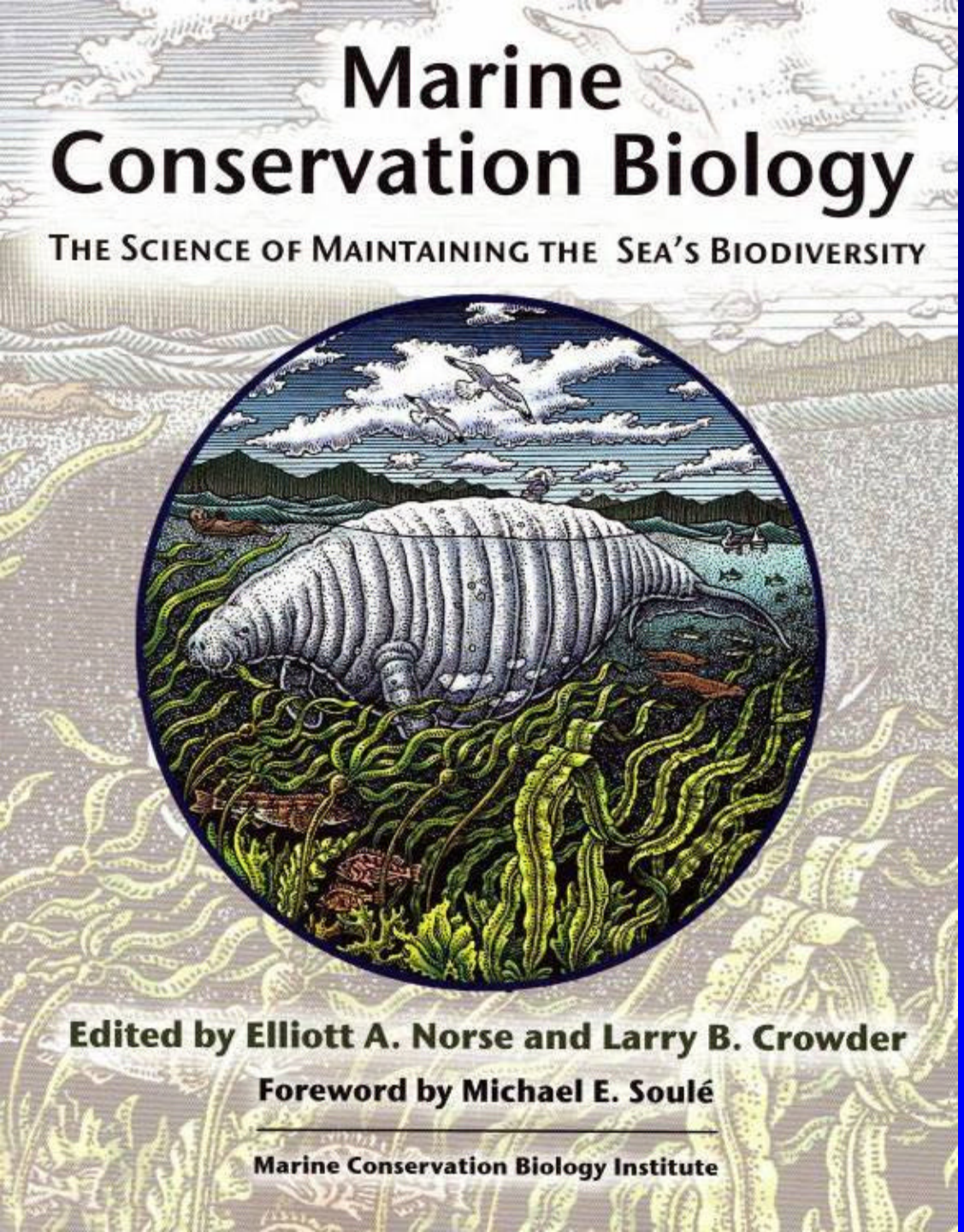
In rezoning Great Barrier Reef Marine Park, experts identified 70 ecosystem types or “bioregions” (30 reef, 40 non-reef)

GBRMP Rezoning was Based on Key Principles:

- Protecting the resource comes first; all uses must be compatible with conservation goals
- Protect a minimum of 20% per ecosystem type in no-take areas
- Represent the full range of plant and animal diversity, from north to south *and* from inshore to offshore
- Have ample public participation in the decision

Great Barrier Reef Marine Park Zoning Map





E.A. Norse (2005). Ending the range wars on the last frontier: Zoning the sea

E.A. Norse &
L.B. Crowder
Marine Conservation Biology:
The Science of Maintaining the Sea's Biodiversity

What Can NOAA Fisheries Do for Starters?

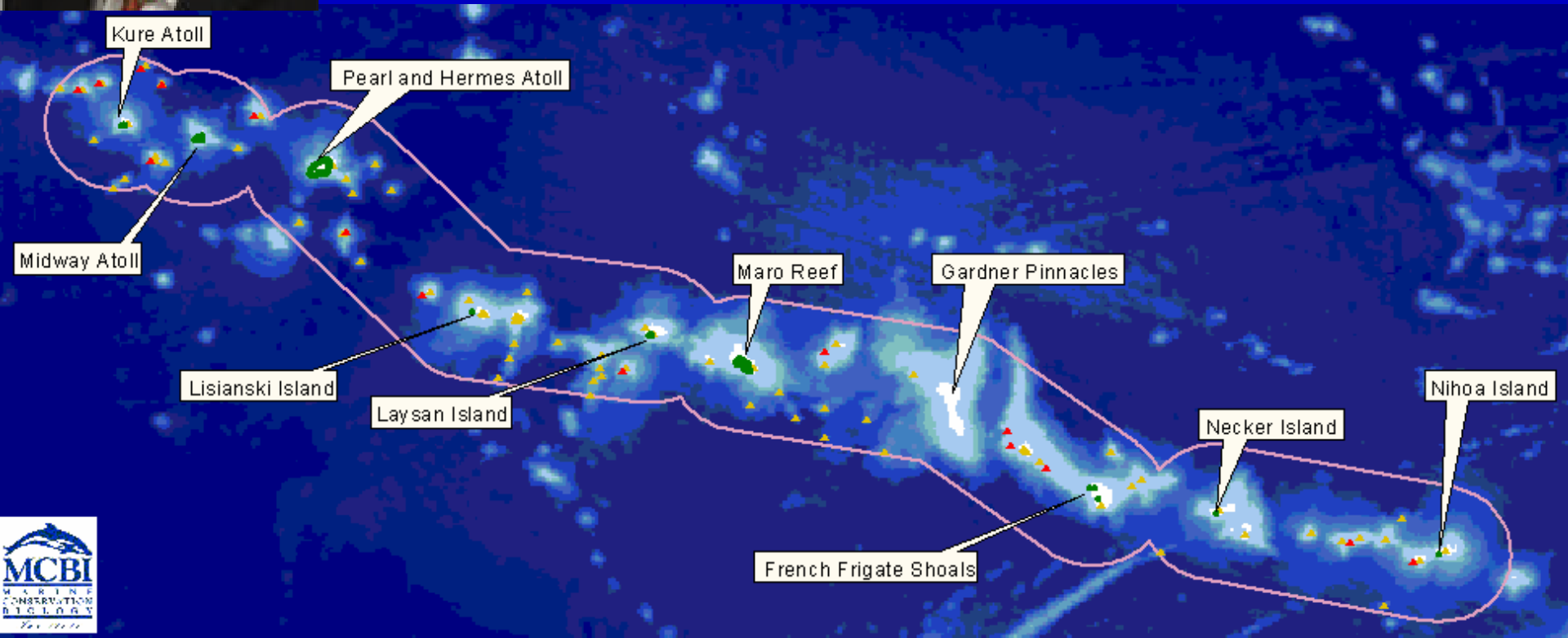
- Recognize that fishing is only *one* important value of oceans, and embrace use of no-take reserves and zones that limit destructive fishing gears
- Cooperate with other parts of NOAA that already use the place-based approach
- Work to reduce influence of Fishery Management Councils in conservation decision making

Remove Ecosystem Decisions from *Financially Interested Interests*

- Support establishment of an independent federal panel of scientists who would set conservation goals and objectives using the ecosystem approach, and establishment of regional ecosystem management councils to make all conservation decisions
- Removing conflict-of-interest would allow NOAA Fisheries to recover America's fisheries, protected species and marine ecosystems

Make History by Supporting *Full Protection* of the NW Hawaiian islands

The Bush Administration and Governor Lingle want the NWHI to be a no-take National Marine Sanctuary



MCBI
MARINE CONSERVATION BIOLOGY

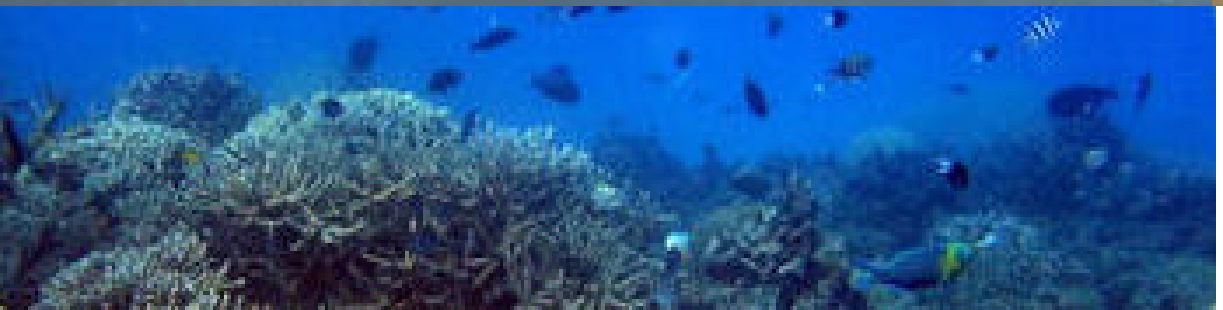
Partner with People *Other than Fishermen* Who Understand the Sea

I invite NOAA Fisheries to sponsor MCBI's Mia J. Tegner Grants in Marine Environmental History and Historical Marine Ecology

These fund studies of the past to help managers set sound population and ecosystem targets

(e.g., J. Roman and S.R. Palumbi (2003) Whales before whaling in the North Atlantic. *Science* 301: 508-510

Let’s Restore America’s Marine Ecosystems!



www.mcbi.org